Amendments to the Claims

This listing of claims will replace all prior versions and listings of claims in the application:

Listing of Claims

1. (Previously Presented) A computer implemented method of operating a boiler system having a plurality of boiler stages which may be active or inactive at a given tine, the boiler stages having outputs, the method comprising:

performing a boiler staging sequence, at a fist timed interval, to determine how many of the plurality of boiler stages should be active or inactive, the boiler staging sequence including:

implementing a boiler addition control loop to make a first number of the plurality of boiler stages active based at least partially on a calculated error rate, and

implementing a boiler removal control loop to make a second number of the plurality of boiler stages inactive based at least partially on the calculated error rate; and

performing a boiler modulation sequence, at a second timed interval shorter than the first timed interval, the boiler modulation sequence including:

using the determinations made during the boiler staging sequence as to how many of the plurality of boiler stages should be active and inactive;

modulating a first boiler stage to operate at less than 100% of its output, and

modulating a second boiler stage to operate at less than 100% of its output;

wherein the first and second boiler stages are modulated while both boiler stages are active.

2. (Previously Presented) The computer implemented method of claim 1 wherein each of the plurality of boiler stages is an individual boiler, and wherein the step of performing a boiler staging sequence determines how many individual boilers should be active.

3. (Previously Presented) The computer implemented method of claim 1 further comprising the step of performing a selecting sequence to determine which of the boiler stages should be active.

4. (Previously Presented) The computer implemented method of claim 3 wherein the selecting sequence includes a first on/first off method.

5. (Previously Presented) The computer implemented method of claim 3 wherein the selecting sequence is adapted to equalize the time in which the boiler stages are active.

6. (Previously Presented) A controller for a boiler system, the controller performing the steps of claim 5.

7. (Previously Presented) A controller for a boiler system, the controller performing the steps of claim 1.

8. (Previously Presented) A computer implemented method of providing heat capacity in response to a heat load using a boiler system having a plurality of boiler stages that may be active or inactive at a given time, the method comprising:

performing a boiler staging sequence, at a first timed interval, to determine which of the plurality of boiler stages should be active or inactive, the boiler staging sequence including:

implementing a boiler addition control loop to make a first number of the plurality of boiler stages active based at least partially on a calculated error rate,

implementing a boiler removal control loop to make a second number of the plurality of boiler stages inactive based at least partially on the calculated error rate, and

activating the determined active boiler stages, if any; and

performing a boiler modulation sequence, at a second timed interval shorter than the first timed interval, the boiler modulation sequence including:

using the determinations made during the boiler staging sequence as to how many of the plurality of boiler stages should be active and inactive;

and when the determined active boiler stages includes two or more of the plurality of boiler stages, modulating the active boiler stages, while they are active.

9. (Previously Presented) The computer implemented method of claim 8 wherein the step of modulating the active boiler stages includes modulating each active boiler stage to substantially the same level of modulation.

10. (Previously Presented) The computer implemented method of claim 8 wherein the step of modulating the active boiler stages includes sending a modulation signal to each of the active stages from a single controller.

11. (Previously Presented) A controller for a multi-boiler system, the controller performing the steps of claim 8.

12. (Previously Presented) A computer implemented method of operating a boiler system having a plurality of boiler stages that may be active or inactive at a given time, the method comprising the steps of:

performing, at a first timed interval, a boiler staging sequence to determine how many of the boiler stages should be active or inactive, the boiler staging sequence including:

implementing a boiler addition control loop to make a first number of the plurality of boiler stages active based at least partially on a calculated error rate, and

implementing a boiler removal control loop to make a second number of the plurality of boiler stages inactive based at least partially on the calculated error rate; and

performing, at a second timed interval shorter than the first timed interval, a modulating boiler sequence to modulate the active boiler stages, the modulating boiler sequence including:

setting values for use in the modulating boiler sequence, which includes the setting of the total heat command to the amount of heat demanded at that particular time, and

using the determinations made during the boiler staging sequence as to how many of the plurality of boiler stages should be active and inactive.

13. (Previously Presented) The computer implemented method of claim 12 wherein the boiler staging sequence includes a sub-method for making an inactive boiler stage active and a sub-method for making an active boiler stage inactive, wherein:

the sub-method for making an inactive boiler stage active is disabled for a first time period after an inactive boiler stage is made active;

the sub-method for making an active boiler stage inactive is disabled for a second time period after an active boiler stage is made inactive; and

the second time period is shorter than the first time period.

14. (cancel)

15. (Previously Presented) The computer implemented method of claim 12 wherein the boiler system includes a number of separate boilers, wherein each boiler represents a boiler stage.

16. (Previously Presented) A controller for a boiler system, the controller performing the steps of claim 12.

17. (Previously Presented) A computer implemented method of controlling a multi-stage boiler system having a number of boiler stages that can be either active or inactive, the method comprising the steps of:

calculating an error based upon a difference between a boiler system fluid return temperature and a setpoint;

determining whether to make an inactive boiler stage active based at least partially on the calculated error; and

determining whether to make an active boiler state inactive based at least partially on the calculated error; wherein:

a first time delay is provided after making an inactive boiler stage active and before a determination is made whether or not to activate any additional boiler stages,

a second time delay is provided after making an active boiler stage inactive and before a determination is made whether or not to deactivate any additional boiler stages;

wherein the first time delay is longer than the second time delay; and

wherein the first and second time delays are used to preserve stability in the multi-stage boiler system by limiting over-cycling due to excessively quick staging.

18. (Previously Presented) A computer implemented method of staging and modulating a boiler system in response to a load comprising the steps of:

staging and modulating the boiler system using a first control method that is adapted for achieving increased efficiency under a first set of boiler system conditions, which first set of conditions include a calculated system error being less than a predetermined quantity; and

staging and modulating the boiler system using a second control method that is adapted to allow cycling of boiler stages under a second set of boiler system conditions, which second set of conditions include a boiler being taken offline for maintenance;

wherein at least one of the first control method and the second control method includes:

performing, at a first timed interval, a boiler staging sequence to determine how many of the boiler stages should be active; and

performing, at a second timed interval shorter than the first timed interval, a modulating boiler sequence to modulate the active boiler stages.

19. (Previously Presented) The computer implemented method of claim 18 wherein at least one of the second set of conditions is that the load exceeds a threshold.

20. (Previously Presented) The computer implemented method of claim 18 wherein at least one of the second set of conditions is that the boiler system has operated by staging and modulating using the first control method for a predetermined time period.

21. (Previously Presented) The computer implemented method of claim 18 wherein the first set of conditions includes non-occurrence of all of the second set of conditions.

22. (Previously Presented) The computer implemented method of claim 18 wherein both of the first control method and the second control method includes:

performing, at a first timed interval, a boiler staging sequence to determine how many of the boiler stages should be active; and

performing, at a second timed interval shorter than the first timed interval, a modulating boiler sequence to modulate the active boiler stages.

23. (Previously Presented) The computer implemented method of claim 18 wherein at least one of the first control method and the second control method includes a sub-method for making an active boiler stage inactive and a sub-method for making an inactive boiler stage inactive, wherein:

the sub-method for making an inactive boiler stage active is disabled for a first time period after an inactive boiler stage is made active;

the sub-method for making an active boiler stage inactive is disabled for a second time period after an active boiler stage is made inactive; and

the second time period is shorter than the first time period.

24. (Previously Presented) A boiler system comprising:

a controller configured to perform the method of claim 18; and

a switch;

wherein the first set of conditions includes having the switch in a first configuration, and the second set of conditions includes having the switch in a second configuration, the switch adapted to allow a user to manually select one of the first configuration or the second configuration.

25. (Previously Presented) A computer implemented method of performing a staging sequence for a multi-stage boiler system in which at least one boiler stage can be either active or inactive, the method comprising the steps of:

calculating an error based upon a difference between a boiler system fluid return temperature and a setpoint;

determining a rate of change of the error, the rate of change of the error being determined based upon a computed difference between a current measured value and an old measured value of the boiler system fluid return temperature;

and mathematically combining the error and the rate of change of the error to determine whether:

an inactive boiler stage should become active;

an active boiler stage should become inactive;

or, if it is determined that neither an inactive boiler stage should become active nor an active boiler stage should become inactive, determining that no change in the umber of active stages is necessary.

26. (Previously Presented) A controller for a boiler system, the controller performing the method of claim 25.

27. (Previously Presented) A computer implemented method as in claim 1 wherein the steps of modulating a first boiler stage to operate at less than 100% of its output and modulating a second boiler stage to operate at less than 100% of its output are such that both the first and second boiler stages operate at less than 100% of their respective outputs at the same time.